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Clinical practices to promote sleep in the ICU: a multinational survey

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The role of authors and contributors

PS, JH and LR conceived of the study. JH, LR, BB, EA, JM, IE, MF, HF, EG, HJG, MK, RS, AB, AS, and AGW distributed the questionnaires in their specific countries and made sure the data were assembled in the right way. JH and PS coordinated data-assembly, cleaned the database and performed final analysis. JH, PS, LR, BB and IE drafted the paper. All authors approved the final version of the manuscript.

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Abstract

Purpose: To describe sleep assessment and strategies to promote sleep in adult ICUs in ten countries.

Methods: Multicenter, self-administered survey sent to nurse managers.

Results Response rate was 66% with 522 ICUs providing data. 'Lying quietly with closed eyes' was the characteristic most frequently perceived as indicative of sleep by >60% of responding ICUs in all countries except Italy. Few ICUs (9%) had a protocol for sleep management or used sleep questionnaires (1%). Compared to ICUs in Northern Europe, those in central Europe were more likely to have a sleep promoting protocol ($p<0.001$), and to want to implement a protocol ($p<0.001$). In >80% of responding ICUs, the most common non-pharmacological sleep-promoting interventions were reducing ICU staff noise, light, and nurse interventions at night; only 18% used earplugs frequently. Approximately 50% of ICUs reported sleep medication selection and assessment of effect were performed by physicians and nurses collaboratively. A multivariable model identified perceived nursing influence on sleep decision-making was associated with asking patients or family about sleep preferences ($p=0.004$).

Conclusions We found variation in sleep promotion interventions across European regions with few ICUs using sleep assessment questionnaires or sleep promoting protocols. However, many ICUs perceive implementation of sleep protocols important, particularly those in central Europe.

Keywords: intensive care; inter-professional collaboration; sleep; survey

What is already known about the topic?

- Sleep disturbances are common in critically ill patients treated in the intensive care unit (ICU) and may persist after ICU discharge.
- International data describing sleep assessment and promotion practices in the adult ICU is scarce
- The ICU inter-professional team plays an important role in sleep assessment and use of sleep promoting strategies.

What this paper adds

- This paper describes international sleep practices in the ICU with a focus on Europe.
- We found international infrequent use of objective tools to assess sleep and low adoption of sleep protocols whereas many ICUs perceive implementation of sleep protocols important, particularly those in central Europe.
- This paper provides evidence that in those ICUs with high levels of perceived nursing influence, patients were more likely to be asked about sleep preference, suggesting this is perceived an important assessment by nurses.

Introduction

Sleep disturbances are common in critically ill patients during intensive care unit (ICU) admission and may persist or develop after critical illness [1]. The relationship between the poor sleep in critically ill patients and their long-term outcome remains unknown [1]. Critically ill patients report sleep disturbance as one of the biggest causes of stress while in the ICU [2–4]. Sleep is important for overall well-being, while sleep-related problems may persist after ICU discharge [5,6]. Sleep in the ICU is often fragmented and disrupted [7] which may be exacerbated by sedative medications [8]. Other factors that may contribute to sleep abnormalities in critically ill patients include pain and discomfort, excessive light and noise during the night interrupting circadian rhythm, delirium, and mechanical ventilation [7]. Effective interventions to promote a normal sleep-wake cycle for critically ill patients are needed. In particular, non-pharmacological strategies without the side effect profile of pharmacological interventions should be prioritized [9]. However, little international data describes sleep assessment and promotion practices in the adult ICU. Understanding sleep in the critically ill is hampered by the fact that it is difficult to distinguish sleep from sedation and that sedation may be used to promote sleep. Little is known about clinical roles and responsibilities regarding key sleep practices to promote patient sleep and related contextual factors that may influence the quality of sleep of ICU patients. A better understanding of sleep in adult ICUs from an international perspective might help to identify best practices that may then be translated across different ICU contexts [10]. Therefore, we conducted this study with the aim of describing clinical practices used to promote sleep in the adult ICUs of ten countries. A secondary aim was to evaluate roles and responsibilities of the ICU interprofessional team in relation to key sleep promoting decisions. We hypothesized

that substantial variation would exist between countries with respect to sleep practices, and roles and responsibilities.

Materials and Methods

Design and setting

We conducted a multicenter, self-administered survey sent to nurse managers of adult ICUs across 10 countries. In most participating countries, nurse managers of *all* adult ICUs were approached to participate (Poland, Denmark, Cyprus, Greece, Norway, Sweden, the Netherlands, UK (except Scotland). In other countries, nurse managers of ICUs either within a region of the country (e.g. Italy: Piedmont and Valle D'Aosta, Canada: Ontario), or in all regions, but not all hospitals (Germany) due to inability to obtain nurse manager contact details, were invited to participate. Nurse managers were specifically directed to discuss the questionnaire with other senior ICU nurses to improve the validity of data provided.

Survey Development

In discussion with country lead investigators, we reviewed our previously developed Dutch survey of sleep practices [11] and iteratively modified to include contextually relevant items applicable to participating countries. Additionally, we performed a search in PUBMED and EMBASE databases using the terms: “sleep”, or “sleep practices”, and “intensive care” to capture recent issues relevant to sleep practices. Co-investigators iteratively refined survey items via email and teleconference discussion for face and content (validity of survey). The final survey was translated from Dutch into English and then back translated by an experienced translator in consultation with two clinical experts. For administration in non-English speaking

countries, the survey was translated and back translated by an experienced native translator, in consultation with the lead investigator for that country (electronic supplementary material- ESM-1).

Survey:

The final survey (ESM-2) comprised several domains and items addressing recognition of sleep in the critically ill, frequency (never to routinely) of use of current sleep practices, roles and responsibilities in terms of decision making related to sleep, and nursing autonomy and influence on sleep practices in the ICU. After discussion with their senior nursing team, ICU nurse managers were asked to rate perceived patient sleep quality on a 0 (very poor) to 10 (excellent) numeric scale and perceived nursing autonomy and influence on a 0 (no autonomy or influence) to 10 (complete autonomy or influence) numeric scale.

Data collection

Research Ethics approval for survey conduct was obtained according to the requirements of each country. Return of survey was considered indicative of consent. In each country, a lead investigator coordinated survey distribution and reminders. The survey was distributed in 2014- 2015 via mail (Netherlands), email (Germany, Denmark, Cyprus, Greece, Italy, Norway, Sweden, Canada), or as a link hosted on professional society websites (UK, Poland). Prior to survey distribution, each ICU was contacted by telephone to determine the most appropriate senior nurse with whom to correspond. One to four survey completion reminders (varied across countries) were sent via mail, email, or telephone every two to four weeks.

Data management

Survey data were checked and entered into a specifically designed excel database by the lead investigator for each country and then sent to the coordinating center in the Netherlands for cleaning and analysis (JH, PS).

Data Analysis

We collapsed Likert scale questions with five responses into two nominal categories: frequently (frequently/often/routinely) and seldom (never/seldom). Continuous data such as characteristics of participating ICUs, staffing, and total scores of numeric scales are expressed as medians and interquartile range (IQR) due to non-normal distribution; counts and proportions for categorical data. We used Kruskal-Wallis tests to compare responses between countries described by continuous data and Chi square or Fisher exact tests, if applicable, for categorical data. For yes/no questions related to sleep/sedation practices we reported the “percent” as opposed to the “valid percent” i.e. calculated excluding missing values under the assumption that participants who didn’t answer skipped the question implying a “no” answer [12]. For percentages of socio-demographic variables we used the “valid percent”, assuming that the missing values were distributed proportionately among response categories.

We created four regression models of dependent variables relating to clinical practice likely to be modifiable using general estimation equations (GEE) using Proc GLIMIX in SAS [13] to account for clustering by country and using the Fay-Graubard [14] empirical covariance estimator. We tested for multicollinearity and examined associations with a priori selected independent variables (country grouped according to regions: southern, central and northern; hospital type; ICU specialty; ICU type; ICU

bed numbers (per 3); nurse autonomy and nurse influence). The four models were chosen as they may influence future practice change: (1) use of a sleep protocol; (2) willingness to use a sleep protocol in the future; (3) use of a sleep questionnaire; and (4) asking patients or family members about sleep preferences, pharmacological or non-pharmacological strategies used at home to promote sleep and known sleep problems. Missing data ranged from 6% to 12.3% across the models. For the purposes of multivariable modeling we grouped countries according to regions: Southern (Cyprus, Greece, Italy), Central (Germany, Poland), and Northern (Denmark, Netherlands, Norway, Sweden, UK, Canada) based on categories previously described in other European surveys [15,16].

Although there was a lack of strong evidence suggesting the need to include a non-linear specification for the number of ICU beds; we changed the unit of measurement from 1 to 3 beds to increase interpretability. We considered a *p* value of <0.05 statistically as significant with Bonferroni correction due to the number of related tests conducted. Data were analyzed using SAS (9.4 (SAS Institute Inc., Cary, NC, USA) and the Statistical Package for the Social Sciences, version 18 (SPSS Inc, Chicago, IL, USA).

Results

Overall survey response rate was 66% providing data from 522 ICUs for evaluation. There was substantial variation in the number of responding ICUs from each country (range 100% Cyprus (n=10/10) to 32% (n=48/150) UK). Of the 522 ICUs, the majority were in community teaching and non-teaching hospitals (363,70%), were intensivists (369, 76%), and were mixed medical/surgical (385,79%) (Table 1).

Recognition of sleep and sleep preferences

In six countries, >70% of the responding ICUs reported that a patient's history of sleep problems and preferences was sought. However, these practices were most frequent in the Scandinavian countries, the Netherlands and Canada and least frequent in Greece, Germany, Poland, and Cyprus (Table 2). The most common patient characteristics reported as used for enabling recognition of sleep were 'lying quietly with closed eyes' (409 ICUs, 78%), decreased blood pressure (343 ICUs, 66%), and a slow and regular respiratory rate (307 ICUs, 60%) (ESM-3).

Table 1. ICU Demographic Characteristics

	All (n=522)	Cyprus (n=10)	Denmark (n=26)	Germany (n=34)	Greece (n=27)	Italy (n=36)	Netherland (n=69)	Norway (n=50)	Poland (n=73)	Sweden (n=67)	UK (n=48)	Canada (n=82)
Response rate (%)	66	100	60	34	54	72	60	86	73	84	32	76
Hospital type												
University affiliated	134 (27)	1 (10)	14 (54)	18 (53)	-	-	8 (12)	14 (28)	15 (21)	21 (32)	21 (47)	22 (33)
Community/teaching	166 (32)	-	12 (46)	14 (41)	-	12 (33)	32 (49)	10 (20)	15 (21)	28 (43)	16 (36)	27 (41)
Community non-teaching	197 (38)	9 (90)	-	2 (6)	27 (100)	24 (67)	25 (39)	26 (52)	43 (59)	16 (25)	8 (18)	17 (26)
ICU specialty												
Medical only	17 (4)	-	-	1 (3)	-	1 (3)	-	9 (18)	-	3 (5)	1 (2)	2 (3)
Mixed medical/surgical	183 (38)	2 (20)	19 (73)	14 (45)	16 (59)	10 (28)	31 (48)	16 (32)	26 (36)	22 (34)	21 (46)	6 (10)
Mixed units	202 (41)	5 (50)	6 (23)	3 (10)	2 (7)	12 (33)	29 (45)	19 (38)	34 (47)	29 (45)	17 (37)	46 (78)
Surgical only	21 (4)	-	-	5 (16)	2 (7)	1 (3)	1 (2)	4 (8)	3 (4)	4 (6)	-	1 (2)
Cardiovascular	39 (8)	2 (20)	-	5 (16)	6 (22)	11 (31)	1 (2)	2 (4)	5 (7)	2 (3)	4 (9)	1 (2)
Trauma/neurological	24 (5)	1 (10)	1 (4)	3 (9)	1 (4)	1 (3)	3 (5)	-	5 (7)	3 (5)	3 (7)	3 (5)
Burns	2 (0.4)	-	-	-	-	-	-	-	-	2 (3)	-	-
ICU type												
Closed (intensivist-led)	369 (76)	5 (50)	26 (100)	10 (33)	22 (82)	22 (61)	56 (93)	21 (42)	58 (80)	55 (87)	43 (90)	51 (79)
Open (physician of any specialty)	119 (25)	5 (50)	-	20 (67)	5 (19)	14 (39)	4 (7)	29 (58)	15 (20)	8 (13)	5 (10)	14 (22)
ICU bed numbers												
≤ 8 beds	238 (49)	5 (50)	4 (16)	2 (6)	13 (48)	26 (74)	25 (39)	27 (57)	48 (66)	46 (71)	26 (58)	16 (25)
9-16 beds	156 (32)	4 (40)	19 (76)	8 (25)	12 (44)	9 (26)	29 (45)	10 (21)	19 (26)	16 (25)	10 (22)	20 (32)
> 16 beds	93 (19)	1 (10)	2 (8)	22 (69)	2 (7)	-	11 (17)	10 (21)	6 (8)	3 (5)	9 (20)	27 (43)
Number of nurses	24954	310	1671	2000	600	587	3404	1899	1739	4743	2934	5067
Median	39	26	62	53	16	15	36	31	19	69	50	65
IQR	20-65	20-35	55-75	30-66	15-30	9-23	25-61	18-52	13-28	50-96	42-87	38-111

All data are n (%) unless otherwise indicated. Numbers and percentages may not add to 100% due to rounding. Data are valid percentages (not including missing values).

Regions: * **Northern**: Denmark, Netherlands, Norway, Sweden, UK, Canada. ***Central**: Germany, Poland. * **Southern**: Cyprus, Greece, Italy.

Table 2. Sleep practices

	All (n=522)	Cyprus (n=10)	Denmark (n=26)	Germany (n=34)	Greece (n=27)	Italy (n=36)	Netherlands (n=69)	Norway (n=50)	Poland (n=73)	Sweden (n=67)	UK (n=48)	Canada (n=82)	P value
History of sleep problems and sleep medication on ICU admission													
Yes	363 (70)	6 (60)	22 (85)	20 (59)	7 (26)	29 (80)	58 (84)	37 (74)	44 (60)	48 (72)	32 (67)	60 (73)	<0.001
Assess sleeping preferences													
Yes	418 (80)	6 (60)	26 (100)	20 (59)	14 (52)	36 (100)	61 (88)	50 (100)	52 (71)	48 (72)	45 (94)	60 (73)	<0.001
Use a sleep-questionnaire													
Yes	6 (1)	-	-	-	-	1 (3)	-	1 (2)	2 (3)	-	1 (2)	1 (1)	0.820
Protocol/guideline for sleep available													
Yes	49 (9)	-	-	-	1 (4)	2 (6)	8 (12)	7 (14)	1 (1)	22 (33)	2 (4)	6 (7)	<0.001
Like to see protocol implemented in the future													
Yes	376 (72)	10 (100)	25 (96)	17 (50)	27 (100)	33 (92)	47 (68)	43 (86)	43 (59)	46 (69)	40 (83)	45 (55)	<0.001

All data are n (%). Numbers and percentages may not add up to 100% due to missing data or rounding

Regions: * **Northern**: Denmark, Netherlands, Norway, Sweden, UK, Canada. ***Central**: Germany, Poland. * **Southern**: Cyprus, Greece, Italy.

However, there was variability in the use by ICUs of these characteristics across countries (all $P < 0.001$). Greater consistency was found across countries for patient characteristics infrequently used to recognize sleep including: increased blood pressure (8, 2%, $p=0.65$) and slow, shallow respirations (12, 2%, $p=0.93$). Average sleep quality was perceived as moderate; median overall score 5 (scored 0 to 10, with 0 = very poor and 10 = excellent), (highest score of 7 in Cyprus and Greece; lowest score of 3.5 in German ICUs).

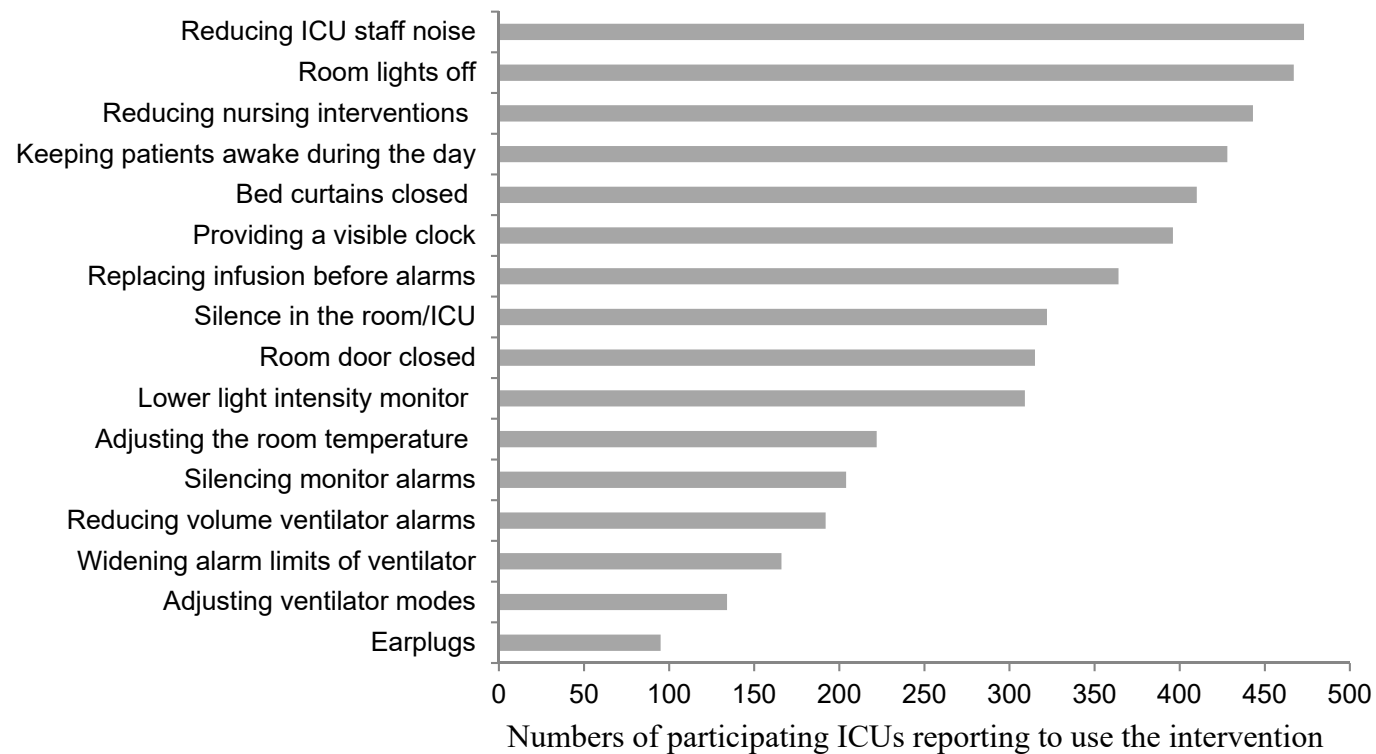
Protocols or guidelines for sleep

Availability of a protocol/guideline for sleep was infrequent (9%) across all countries. However, 72% of all responding ICUs indicated they would like to implement such a protocol/guideline in the future. Few ICUs (1%) used a questionnaire to assess sleep with low adoption consistent across countries (Table 2).

Non-pharmacological and pharmacological interventions for sleep

Non-pharmacological interventions used to promote sleep are shown in Figure 1. (Individual country data in ESM-4). We found considerable variability in the type of non-pharmacological interventions used across countries ($P < 0.001$; all items). Non-pharmacological interventions used greater than 50% of the time by more than 80% of responding ICUs were: (1) reducing noise generated by ICU staff (except Canada 78%); (2) turning room lights off (except Germany 59% and Italy 75%); (3) reducing nurse interventions at night (except Greece 63%); and (4) keeping patients awake during the day (except Germany 79%, Poland 69%, Cyprus 50%, and Greece 26%). Earplugs were used by only 18% of ICUs and only 37% reduced ventilator alarm volume at night on a frequent basis.

Figure 1. Non-pharmacological interventions to promote sleep (N=522)



Pharmacological interventions to promote sleep are shown in Figure 2 Panel A (individual country data in ESM-5). Benzodiazepines were used by 59% of ICUs to promote sleep, most commonly lorazepam (157, 30%), temazepam (110, 21%), and nitrazepam (43, 8%). The next most common agent used was melatonin (84, 16%). As with non-pharmacological interventions, we found considerable variability in the type of pharmacological interventions used across countries ($P < 0.001$ for all pharmacological interventions except Chloral hydrate, which was never or infrequently used by ICUs in all countries $P = 0.67$) (Figure 2 Panel A, ESM-5).

Decisions regarding sleep practices

Forty-nine per cent of responding ICUs reported that selection of medication to promote sleep was performed by physicians and nurses based on collaborative discussion. Lowest rates of inter-professional decision-making were reported by Poland (45%), Greece (41%), the Netherlands (41%), and Canada (1%) where this decision is more commonly performed by physicians and pharmacists in collaboration. Medication selection by a physician without consultation with other team members was reported by 31% of responding ICUs. Physicians and nurses together assessed medication's effect on sleep in 55% of ICUs, with lower rates reported in Sweden (46%) and Canada (2%). Assessment of effect by a physician only was uncommon (5% overall) (Table 3).

Autonomy and nurses' influence on sleeping practices

Participants scored nursing autonomy for management of sleep as moderate; median overall score of 5; (highest score of 7 in Canada, Greece, Sweden and lowest score of 4 in Norway, Poland).

Figure 2 Panel A. Pharmacological interventions to promote sleep (N=522)

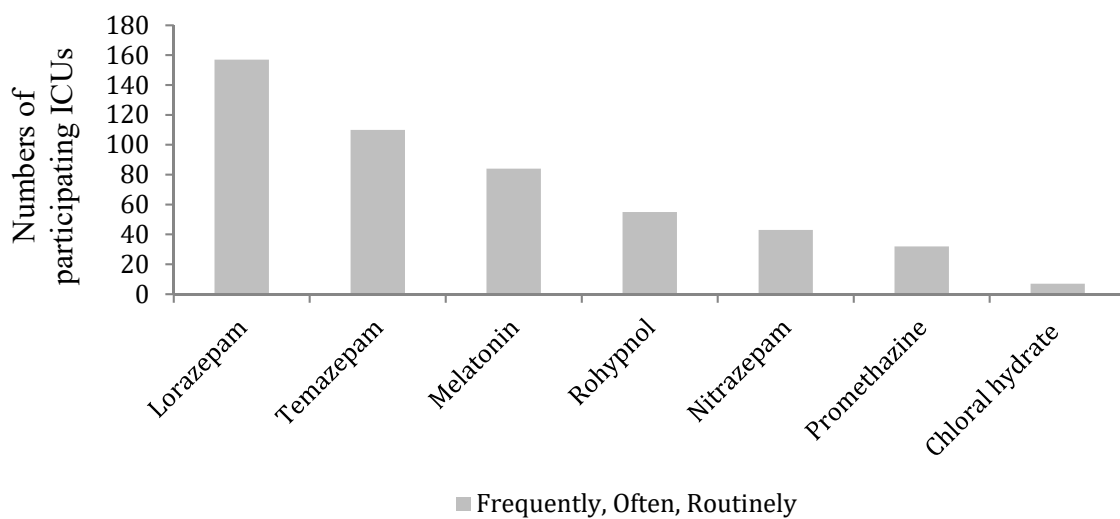
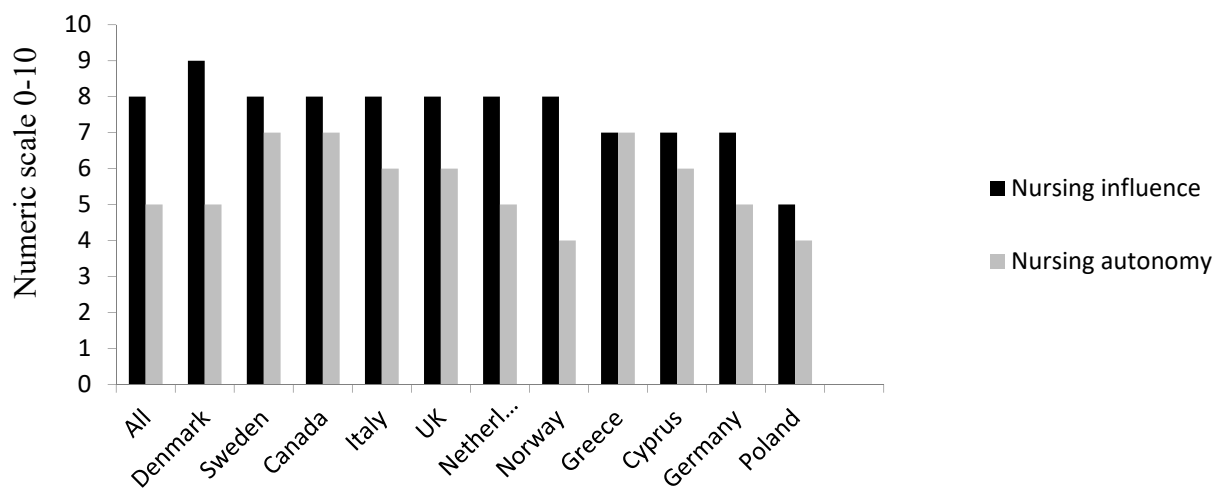


Figure 2 Panel B Rating of perceived nursing influence and autonomy for sleep practices in the ICU



Median scores (scale 0 = no influence or autonomy and 10 = complete influence or autonomy)

Table 3. Decisions regarding sleep medication

	All (n=522)	Cyprus (n=10)	Denmark (n=26)	Germany (n=34)	Greece (n=27)	Italy (n=36)	Nether- lands (n=69)	Norway (n=50)	Poland (n=73)	Sweden (n=67)	UK (n=48)	Canada (n=82)	P value
Factors guiding administration of sleep medication													
Sedation score	10 (2) ^d .	-	-	3 (9)	-	-	2 (3)	-	5 (7)	-	-	25 (31) ^d	<0.001*
Clinical assessment	153 (29)	6 (60)	-	14 (41)	11 (41)	21 (58)	18 (26)	23 (46)	33 (45)	16 (24)	11 (23)	39 (48)	
Both of above	232 (44)	2 (20)	25 (96)	14 (41)	7 (26)	12 (33)	46 (67)	25 (50)	17 (23)	49 (73)	35 (73)	57 (70)	
Neither of above	8 (2)	-	-	1 (3)	-	3 (8)	-	2 (4)	1 (1)	-	1 (2)	-	
Other ^a	17 (3)	-	-	1 (3)	-	-	2 (3)	-	12 (16)	2 (3)	-	-	
Patient/family request	12 (2)	2 (20)	-	-	5 (19)	-	-	-	5 (7)	-	-	49 (60)	
Profession responsible for decisions relating to sleep medication prescription													
Physicians only	161 (31)	5 (50)	-	6 (18)	16 (59)	-	40 (58)	22 (44)	36 (49)	4 (6)	19 (40)	13 (16)	<0.001*
Physicians and nurses	256 (49)	5 (50)	26 (100)	27 (80)	11 (41)	36 (100)	28 (41)	-	33 (45)	60 (90)	29 (60)	1 (1)	
Nurses only	39 (8)	-	-	-	-	-	-	28 (56)	-	1 (2)	-	10 (12)	
Other ^b	52 (10)	-	-	-	-	-	-	-	4 (6)	2 (3)	-	46 (56)	
Profession responsible for determining effect of sleep medication													
Physicians only	27 (5)	3 (30)	-	2 (6)	5 (19)	1 (3)	2 (3)	-	11 (15)	-	2 (4)	1 (1)	<0.001*
Physicians and nurses	289 (55)	7 (70)	13 (50)	22 (65)	22 (82)	29 (81)	40 (58)	38 (76)	54 (74)	31 (46)	31 (65)	2 (2)	
Nurses only	143 (27)	-	13 (50)	9 (27)	-	6 (17)	26 (38)	12 (24)	8 (11)	32 (48)	15 (31)	22 (27)	
Other ^c	48 (9)	-	-	-	-	-	-	-	-	4 (6)	-	44 (54) ^e	

All data are n (%). Numbers and percentages may not add up to 100% due to missing data or rounding * P significant after Bonferroni correction

^a. anxiety, pain, restlessness, patient or family request.

^b. interprofessional discussion between nurses and doctors

^c enrolled nurse.

^d. In the Canadian survey participants were given the option to tick all that apply therefore the total % is more than 100%.

^e. Other: in Canada this referred to ICU pharmacists and nurses together.

Regions: * **Northern**: Denmark, Netherlands, Norway, Sweden, UK, Canada. ***Central**: Germany, Poland. * **Southern**: Cyprus, Greece, Italy

Nursing influence on decisions related to sleep was perceived as considerable; median overall score 8, (highest score of 9 in Denmark and lowest of 5 in Poland) (Figure 2 Panel B).

Regression Models:

Two of our regression models demonstrated association with the sleep practice of interest and country of ICU location (Table 4). Country region was associated with sleep protocol availability ($p < 0.001$) or wishing to implement one in the future ($p < 0.001$) with ICUs from central Europe most likely to use or want a sleep protocol. Perceived level of nursing influence was the only variable modelled that demonstrated an association with asking about sleep preferences ($p = 0.004$).

Table 4. Regression Models

	Odds Ratio	95% Confidence Interval	P value
Model 1. Use of a sleep protocol			
N=458/522			
Central	0.07	0.01-0.30	<0.001
South	0.28	0.09-0.86	0.027
1. North (ref)	1	1	1
Community non-teaching	0.94	0.24-3.70	0.925
Community teaching	0.97	0.34-2.76	0.958
1.University affiliated (ref)	1	1	1
Open ICU	1.03	0.37-2.85	0.952
1.Closed ICU (ref)	1	1	1
ICU beds (per 3)	0.98	0.80-1.22	0.873
Nursing autonomy	1.05	0.72-1.52	0.806
Nursing Influence	0.96	0.61-1.50	0.856
Model 2. Willingness to use a sleep protocol in the future			
N=425/452			
Central	0.26	0.14-0.47	<0.001
South	5.60	0.74-42.5	0.096
1.North (ref)	1	1	1
Community non-teaching	0.33	0.08-1.37	0.126
Community teaching	0.59	0.13-2.57	0.480
1.University affiliated (ref)	1	1	1
Open ICU	0.47	0.19-1.20	0.116
1.Closed ICU (ref)	1	1	1
ICU beds (per 3)	0.97	0.94-1.00	0.061
Nursing autonomy	1.11	0.97-1.26	0.130
Nursing Influence	0.93	0.78-1.09	0.359
Model 3. Use of a sleep questionnaire			
N=459/522			
Central	0.37	0.13-1.07	0.066
South	0.26	0.03-2.19	0.215
1.North (ref)	1	1	1
Community non-teaching	1.38	0.79-2.43	0.260
Community teaching	0.94	0.50-1.77	0.848
1.University affiliated (ref)	1	1	1
Open ICU	4.65	2.03-10.7	<0.001
1.Closed ICU (ref)	1	1	1
ICU beds (per 3)	0.99	0.96-1.03	0.705
Nursing autonomy	1.04	0.93-1.16	0.494
Nursing Influence	1.04	0.87-1.25	0.663
Model 4. Asking patient/family members about sleep preferences			
N=460/522			
Central	0.62	0.17-2.34	0.484
South	0.45	0.03-6.61	0.562
1.North (ref)	1	1	1
Community non-teaching	1.09	0.27-4.43	0.899
Community teaching	0.72	0.15-3.44	0.680
1.University affiliated (ref)	1	1	1
Open ICU	1.07	0.45-2.57	0.877
1.Closed ICU (ref)	1	1	1
ICU beds (per 3)	0.98	0.88-1.10	0.720
Nursing autonomy	0.96	0.77-1.19	0.720
Nursing Influence	1.36	1.10-1.67	0.004

Regions: * **Northern**: Denmark, Netherlands, Norway, Sweden, UK, Canada. ***Central**: Germany, Poland. * **Southern**: Cyprus, Greece, Italy.

Discussion

To our knowledge, this is the largest multi-national study outside the US describing sleep practices for critically ill adults. We found substantial variation between countries in the 522 adult ICUs surveyed with respect to most sleep assessment and promotion practices. Lack of adoption of sleep questionnaires or sleep promoting protocols was frequent, and common to all countries surveyed. Many ICUs used non-pharmacological measures to promote sleep on a frequent basis, although we detected substantial inter-country variation as to the type of non-pharmacological measures used. Location of ICUs within certain European regions was associated with having a sleep promoting protocol or wishing to implement one, with ICUs in central European countries most likely to see sleep promotion protocols as useful.

ICUs participating in our study reported that sleep was predominantly recognized by patients 'lying quietly with closed eyes' and sleep questionnaires were used rarely. A recent survey of ICU providers predominantly in the US reported a similar finding with only a minority of respondents (32%) having access to a sleep promoting protocol that included a sleep assessment questionnaire [17]. Several studies indicate that clinical and subjective observations by nurses are not reliable indicators of sleep and that questionnaires such as the Richard Campbell Sleep questionnaire may provide more reliable assessment of sleep [18–21]. One potential reason for the lack of adoption of sleep questionnaires may be that they require patients to self-report [22]. Patients may be unable to complete questionnaires or provide unreliable answers due to sedation, delirium, and cognitive impairment [23]. Furthermore, evidence suggests nurses, when asked to report on behalf of patients, tend to overestimate sleep quality and quantity [3,24]. Unfortunately, polysomnography, the

gold standard of sleep measurement, is generally not available for most ICU patients. Actigraphy tends to overestimate sleep and underestimate wakefulness due to reduced activity associated with ICU acquired weakness [25], while bispectral index (BIS) monitoring was designed for monitoring depth of sedation, which is different from sleep. Until the ability to measure sleep in the critically ill is improved, most likely through innovative technology, determination of effective intervention to improve sleep remains challenging.

Our data indicate variability in adoption of relatively inexpensive non-pharmacological interventions that might improve quality and quantity of sleep in critically ill patients [26] such as decreasing monitor alarm volume, turning off room lights, closing ICU room doors to reduce noise, earplugs or decreasing frequency of nursing interventions at night [19,20,27]. This may be due to context specific factors such as an open ICU layout (common in Mediterranean countries), or lower versus higher nurse to patient ratios of 1:1 (frequently 1:1 in Scandinavian countries, Canada and the UK, whereas in 1:2 in the Netherlands, and 1:3 or 1:4 in France or Italy). A recent study showed that earplugs or eye shades were poorly tolerated by patients in the ICU [28] and therefore should be used only for patients who want these interventions and able to remove them. Additionally, a previous systematic review of the effect of non-pharmacological interventions such as noise reduction at night may be variable and not impact total sleep time [9].

Our results indicate that benzodiazepines including lorazepam, temazepam, and nitrazepam were the most common agents used to enable sleep. Melatonin was used by 16% of all ICUs to promote sleep. Minimal empirical evidence is available to

understand the best agent to promote sleep in the ICU that has a negligible side effect profile [29]. The efficacy of melatonin remains unclear [30] and both benzodiazepines and propofol suppress REM sleep stages [31,32]. Therefore sedative drugs may not improve sleep merely induce a sedative state. While no guideline currently exists for sleep management in the ICU, the next iteration of the Society of Critical Care Medicine Pain Agitation and Delirium (PAD) guideline (PAD) guidelines [33] will include recommendations for use of pharmacological and non-pharmacological interventions for sleep [17].

The ICU inter-professional team play an important role in sleep assessment and use of sleep promoting strategies. We found that in those ICUs with high levels of perceived nursing influence, patients were more likely to be asked about sleep preference, suggesting this is perceived as an important assessment by nurses. If nurses perceive ability to influence care they may be more likely to perform assessment such as sleep preferences that contribute to decision making [34]. However nursing autonomy and influence on decision making for sleep practices was variable across the ten countries we studied. This likely relates to context specific factors such as staffing levels, organization hierarchy, role expectations and inter-professional relationships. In most northern European countries, nurses receive a baccalaureate level education and specialty postgraduate nursing education [35], while this may quite different in other European countries. Aiken and colleagues showed that differences in both nursing staffing and nurse education were large across countries and that the definition of bachelor's education for nurses differs by country [36]. Although ours is the first study to examine perceived nursing autonomy for sleep practices, other studies have examined nurses' role on managing sedation.

These studies demonstrate that most nurses were dissatisfied with their level of autonomy for managing sedation and analgesia [37].

Strengths of our study include the large number of participating ICUs with response rates suggesting reasonable generalizability of findings. However, as with any self-report survey, there are also several important limitations. First, nurse managers were asked to provide responses on behalf of their unit. Although we specifically asked them to provide answers reflecting local attitude and practice, subjective assessments such as the perceived level of autonomy and influence were likely influenced by the personal opinions of these nurse managers. Second, nurse managers from units interested in sleep/sedation may have been more likely to participate, which means that our findings may overestimate actual practices in regards to sleep assessment or adoption of sleep promoting practices. Third, some countries had low response rates meaning results from these countries may not be generalizable.

Conclusion

In this large international survey of sleep practices for critically ill adults in primarily European ICUs we found infrequent use of objective tools to assess sleep and low adoption of sleep protocols. We found considerable between country differences in the type of sleep assessment and interventions used, both pharmacological and non-pharmacological, for sleep promotion, although inexpensive interventions to reduce noise and light at night were most commonly reported. Levels of perceived nursing influence regarding sleep decision-making was associated with assessing sleep preferences. Future quality improvement initiatives relating to sleep should target

strategies to increase assessment of sleep preference, documentation of sleep even if restricted to time spent lying with eyes closed, and adoption of sleep promotion protocols that emphasize adoption of inexpensive strategies to reduce noise and light at night

Conflict of interest

The authors declare that they have no conflict of interest

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Legends to the figures

Figure 1.Non-pharmacological interventions to promote sleep (N=522)

Figure 2. Panel A. Pharmacological interventions to promote sleep (N=522)

Figure 2. Panel B Rating of perceived nursing influence and autonomy for sleep practices in the ICU

Legends to the tables

Table 1. ICU Demographic Characteristics

Table 2. Sleep practices

Table 3. Decisions regarding sleep medication

Table 4. Regression models

ESM-1 Summary of the procedure regarding translation and distribution of the questionnaire

	Procedure translation Questionnaire	Distribution of questionnaire and name website if used
Cyprus	Translation by an experienced translator and a panel of 4 experts (in co- operation with Greece)	Nurse manager was first contacted by telephone and after his/her consent to participate the cover letter and survey were sent by e mail. One reminder by telephone.
Denmark	Forward-and backward translated by 2 experienced researchers	SurveyXact was used to distribute the electronic version of the questionnaire and covering letter to the ICU nurses. The first reminder was send out by email. The second reminder was by email and telephone.
Germany	Forward and backward translated	Survey and covering letter distributed by e-mail to each ICU Nursing director One reminder
Greece	Translation by an experienced translator and a panel of 4 experts	Nurse manager contacted by phone and the cover letter with the survey were send by e-mail after a positive replay. They sent it back by e-mail to the Sector "Emergency and Critical Care Nurses" of Hellenic Nurses Association Two remainders by e-mail.
Italy	Translation by two experienced translator and a panel of 2 experts in ICU	Updating mailing list of Piedmont and Valle D'aosta ICU in Italy. The survey was distributed by email to ICU nurse manager. Nursing director for each health institution was contacted by telephone to get the email addresses of nurse manager. Three reminders by email
Netherlands	Translation into English and then back translated by an experienced translator in consultation with two experts	Questionnaire and covering letter was send by post Two reminders by phone and email
Norway	Two references were used for the translation procedure and three critical care nurses pilot tested the instrument and participated in an expert panel. The three critical care nurses and two of the researchers discussed the translation of the instrument.	SurveyXact was used and all ICUs got 1 questionnaire Three reminders by email
Poland	Translation took place by an experienced translator verified for word meaning and clear understanding by 3 ICU nurses and project coordinator on group meeting	Electronic version of the survey on Google platform and link to this was sent by email to nurse manager/ coordinator of all ICU's , also the cover letter was send to participants. Because a complete list of all ICUs in Poland does not exist, the link to website was also sent to regional offices to Polish Association of Intensive Care Nurses with request to redistribute it to ICU nurse managers in their region. https://docs.google.com/forms/d/1QPDlyWToTn4cQWJGrIVZxKF6TQFNJ5-3AA6dqAml5kQ/viewform?usp=send_form
Sweden	Translation by a translator and three critical nurses and the researcher discuss the translation of the instrument	Nurse manager contacted by mail and they contacted the most appropriate nurse to correspondent with. Two reminders by mail, sending the first reminder they contacted the ICU by phone, a second reminder was send if the ICU not respond on the first
UK	NA	Complete directory of adult ICUs, not only send to some ICUs, Questionnaire distributed via Google web-based platform in electronic version and as word document for completion either online or return email. One reminder email sent out via critical care network lead nurses. https://docs.google.com/forms/d/1nMBss84YHwCx6EleHPmQ0cQPaejYLTc4YWjHXqe8LJl/viewform
Canada	NA	Subsequent survey and covering letter was distributed to each ICU Four reminders

ESM-2. Survey of Sleep Practices in the ICU

Dear colleague

You are being invited to take part in a survey. We are surveying nurse managers (after discussing the questionnaire with other senior ICU nurses) of all adult ICUs to learn more about sleep management. We would appreciate if you would take 10 to 15 minutes to complete the questionnaire. Please click on the link below to access the survey.

1. How do you recognise a patient is sleeping in your ICU?

(Please tick all that apply)

- ☐ Patient lying quiet with closed eyes
- ☐ Unintentional muscle movements of arms or legs
- ☐ Decreasing heart-beat
- ☐ Decreased pulse rate
- ☐ Decreased blood pressure
- ☐ Increased blood pressure
- ☐ Decreasing respiratory rate (10-20 bpm)
- ☐ Very slow respiratory rate (<10)
- ☐ Respiration slow and regular
- ☐ Respiration slow, irregular and shallow
- ☐ Snoring (non-ventilated)
- ☐ Other, please specify-----

2a. How regularly are the following non-pharmacological interventions used to improve sleep during the night in your ICU?

	Never (0%)	Seldom (1-25%)	Frequently (26-50%)	Often (51-75%)	Routinely (>75%)
NOISE					
Audible alarm of monitor on silence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reducing ventilator alarms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reducing ICU staff noise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reducing nursing interventions at night	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Replacing infusions before alarms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earplugs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
White noise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Decibel monitor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ENVIRONMENT					
Silence in the room/ICU	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Adjusting the room temperature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Providing a visible clock	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Keeping patients awake during the day	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delaying routine blood work until morning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Changing medication schedules to avoid administration between 23:00 and 05:00	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LIGHT					
Lower light intensity of monitor/ventilator	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Room lights off	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Curtains closed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Room door closed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eye mask	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
VENTILATION					
Adjusting of ventilator modes (e.g. PS→PC)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Widening ventilator alarm limits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How successfully are interventions implemented?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Which intervention is least applied?
Please list and specify

3. Do you consider patients' sleeping preferences?

- ☐ Yes
- ☐ No
- ☐ Other

3a. If other please explain

3b. If no, please explain why?

4. Are patients or their family members asked questions related to sleep problems or the use of sleep medication on ICU admission?

- ☐ Yes
- ☐ No

5. Do you use a sleep-questionnaire in your ICU?

- ☐ Yes
- ☐ No
- ☐ If yes, please state the name of the sleep questionnaire

6. Which factors determine the decision to administer sleep medication?

- ☐ Sedation score (i.e., patient is restless or agitated)
- ☐ Clinical assessment (frequently awake)
- ☐ A combination of sedation score and clinical assessment
- ☐ Not on basis of sedation score or clinical assessment
- ☐ Patient or family member request
- ☐ Other, please specify -----

7. Who decides which sleep medication should be prescribed/administered?

- ☐ Physicians only
- ☐ Physicians and nurses in collaboration
- ☐ Nurses only
- ☐ Other, please specify

8. Who determines the efficacy of sleep medication in terms of helping the patient sleep?

- ☐ Physicians only
- ☐ Physicians and nurses in collaboration
- ☐ Nurses only
- ☐ Other, please specify

9. Which of the following sleep medications do you use in your ICU?

Please indicate the top 5 sleep medications for: a. intravenous b. oral

	Never (0%)	Seldom (1-25%)	Frequently (26-50%)	Often (51-75%)	Routinely (>75%)
Temazepam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Promethazine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lorazepam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nitrazepam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rohypnol	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chloral hydrate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Melatonin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other, please specify	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10a. How would you rate nursing autonomy regarding sleep practices of the ICU patient?

0	1	2	3	4	5	6	7	8	9	10
Dependent										Independent

10b. Please comment (optional)

11a. How often do nurses influence decisions regarding sleep management in ICU patients?

0	1	2	3	4	5	6	7	8	9	10
Never										Always

11b. Please comment (optional)

12. How would you rate sleep quality of the average patient in your ICU?

0	1	2	3	4	5	6	7	8	9	10
Bad										Excellent

13. If you scored question 15 (above) as <7, can you indicate the reason(s) for this?

<input type="radio"/>	Disturbed night/ day cycle
<input type="radio"/>	Noise annoyance (alarms, talking etc)
<input type="radio"/>	Nursing interventions
<input type="radio"/>	Sleeping in an open unit instead of in a single room
<input type="radio"/>	Mechanical ventilation
<input type="radio"/>	Light
<input type="radio"/>	Fear
<input type="radio"/>	Pain
<input type="radio"/>	Delirium
<input type="radio"/>	Anxiety
<input type="radio"/>	Other, please specify-----

14. Do you consult other disciplines when patients are not sleeping well (within a week)?

- ☐ Yes, ☐ Geriatrician
☐ Psychiatrist
☐ Psychiatric nurse consultant
☐ Social worker
☐ Other, please specify -----
☐ No

15a. Do you have a protocol/ guideline for sleep practices in your ICU?

- ☐ Yes
☐ No

15b. If yes, does it provide information on what to do when patients are not sleeping well?

- ☐ Yes
☐ No

15c. Do you agree to send this protocol/guideline to us?

16. If you do not have a protocol, would you like to see a protocol/guideline regarding sleep practices implemented in your ICU?

- ☐ Yes
☐ No

17. Can you tell us why you would like to have a protocol/ guideline regarding sleeping practices in your ICU?
Or, if no, why this is so?

ICU DEMOGRAPHICS

- | | | | |
|--------------------------|---|---|---|
| 18. <u>Hospital type</u> | <input type="radio"/> University affiliated | <input type="radio"/> Community/ teaching | <input type="radio"/> Community/ non-teaching |
|--------------------------|---|---|---|
19. Please identify the primary speciality of your ICU
- | | | | |
|---------------------------------------|---|-------------------------------------|---|
| <input type="radio"/> Surgical (only) | <input type="radio"/> Cardiovascular (only) | <input type="radio"/> Trauma/ Neuro | <input type="radio"/> Mixed Med/surg |
| <input type="radio"/> Medical (only) | <input type="radio"/> Neuroscience (only) | <input type="radio"/> Burns (only) | <input type="radio"/> Mixed med/surg/trauma |
20. ICU type
- | | |
|--|---|
| <input type="radio"/> Closed (Intensivist-led) | <input type="radio"/> Open (under care of physicians from any speciality) |
|--|---|
21. Number of ICUs in the hospital ----- 25. Number of ICU beds -----

22. Please identify the actual numbers of the following staff members:

Number of Registered Nurses -----

23. Do you feel a study assessing interventions to improve sleep/delirium in ICU patient is important?

- ☐ Yes
☐ No

24. Do you think your ICU would consider taking part in a study to prevent sleep disturbance in the ICU?

☐ Yes

☐ No

Thank you for taking your time to complete the questionnaire

ESM-3 Characteristics of sleep

	All (n=522)	Cyprus (n=10)	Denmark (n=26)	Germany (n=34)	Greece (n=27)	Italy (n=36)	Nether- lands (n=69)	Norway (n=50)	Poland (n=73)	Sweden (n=67)	UK (n=48)	Canada (n=82)	P value across groups
Patient lying with closed eyes	409 (78)	10 (100)	24 (92)	23 (68)	22 (82)	13 (36)	62 (90)	47 (94)	49 (67)	48 (72)	41 (85)	70 (85)	<0.001
Decreased blood pressure	343 (66)	7 (70)	26 (100)	29 (85)	18 (67)	5 (14)	57 (83)	36 (72)	37 (51)	54 (81)	35 (73)	39 (48)	<0.001
Respiration slow and regular	307 (60)	0	11 (42)	28 (82)	11 (41)	25 (69)	30 (44)	33 (66)	45 (62)	45 (67)	28 (58)	51 (62)	0.001
Decreasing respiratory rate (10x20 per minute)	306 (59)	5 (50)	24 (92)	23 (68)	14 (52)	21 (58)	58 (84)	26 (52)	39 (53)	50 (75)	24 (50)	22 (27)	<0.001
Decreasing heartbeat	267 (51)	6 (60)	25 (96)	21 (62)	15 (56)	23 (63.9)	61 (88)	0	44 (60)	1 (2)	26 (54)	45 (55)	<0.001
Decreased pulse rate	251 (48)	8 (80)	19 (73)	25 (74)	21 (78)	15 (42)	0	41 (82)	47 (64)	47 (70)	28 (58)	^{a.}	<0.001
Unintentional muscle movement of arms or legs	57 (11)	0	0	6 (18)	0	6 (17)	5 (7)	2 (4)	2 (3)	8 (12)	14 (29)	14 (17)	<0.001
Very slow respiratory rate (<10)	30 (6)	2 (20)	0	2 (6)	5 (19)	0	10 (15)	^{a.}	2 (3)	2 (3)	4 (8)	3 (4)	0.005
Respiration slow, irregular and shallow	12 (2)	0	0	1 (3)	0	1 (3)	0	1 (2)	3 (4)	3 (5)	1 (2)	2 (2)	0.926
Increased blood pressure	8 (2)	0	0	1 (3)	0	0	0	0	2 (3)	3 (5)	1 (2)	1 (1)	0.655

All data are n (%) ^{a.} question not asked in this country

ESM-4 Non-pharmacological interventions to improve sleep

N (%)	All (n=522)	Cyprus (n=10)	Denmark (n=26)	Germany (n=34)	Greece (n=27)	Italy (n=36)	Nether- lands (n=69)	Norway (n=50)	Poland (n=73)	Sweden (n=67)	UK (n=48)	Canada (n=82)	P value All (N=522)
Reducing ICU staff noise	473 (91)	8 (80)	26 (100)	31 (91)	26 (96)	30 (83)	61 (88)	50 (100)	70 (96)	63 (94)	44 (92)	64 (78)	0.002
Room lights off	467 (90)	10 (100)	26 (100)	20 (59)	24 (89)	27 (75)	64 (93)	49 (98)	58 (80)	66 (99)	47 (98)	76 (93)	<0.001
Reducing nursing interventions (night)	443 (85)	7 (70)	26 (100)	29 (85)	17 (63)	29 (81)	60 (87)	47 (94)	70 (96)	60 (90)	34 (71)	64 (78)	<0.001
Keeping patients awake during the day	428 (82)	5 (50)	26 (100)	27 (79)	7 (26)	29 (81)	65 (94)	45 (90)	50 (69)	63 (94)	43 (90)	68 (83)	<0.001
Curtains closed (beds)	410 (79)	6 (60)	26 (100)	19 (56)	21 (78)	21 (58)	51 (74)	50 (100)	56 (77)	64 (96)	33 (69)	63 (77)	<0.001
Providing a visible clock	396 (76)	6 (60)	26 (100)	24 (71)	20 (74)	15 (42)	63 (91)	43 (86)	51 (70)	54 (81)	42 (88)	52 (63)	<0.001
Replacing infusion before alarms	364 (70)	7 (70)	25 (96)	20 (59)	26 (96)	28 (78)	43 (62)	42 (84)	53 (73)	42 (63)	18 (38)	60 (73)	<0.001
Silence in the room/ICU	322 (62)	7 (70)	26 (100)	6 (18)	26 (96)	28 (78)	58 (84)	47 (94)	64 (88)	59 (88)	1 (2)	^a .	<0.001
Room door closed	315 (60)	3 (30)	24 (92)	4 (12)	8 (30)	12 (33)	39 (57)	41 (82)	39 (53)	58 (87)	24 (50)	63 (77)	<0.001
Lower intensity of monitor/ventilator	309 (59)	5 (50)	26 (100)	29 (85)	17 (63)	25 (69)	24 (35)	24 (48)	57 (78)	37 (55)	32 (67)	33 (40)	<0.001
Adjusting the temperature of the room	222 (43)	9 (90)	16 (62)	25 (74)	26 (96)	17 (47)	16 (23)	22 (44)	38 (52)	19 (28)	16 (33)	18 (22)	<0.001
Audible alarm of monitor silence	204 (39)	2 (20)	0	3 (9)	5 (19)	22 (61)	34 (49)	28 (56)	36 (49)	16 (24)	23 (48)	35 (43)	<0.001
Reducing ventilator alarms	192 (37)	1 (10)	1 (4)	11 (32)	0	17 (47)	16 (23)	34 (68)	41 (56)	31 (46)	21 (44)	19 (23)	<0.001
Widening alarm limits of ventilator	166 (32)	3 (30)	20 (77)	17 (50)	1 (4)	7 (19)	25 (36)	32 (64)	20 (27)	31 (46)	10 (21)	^a .	<0.001
Adjusting of ventilator modes (e.g.PS-PC)	134 (26)	3 (30)	1 (4)	13 (38)	1 (4)	9 (25)	10 (15)	26 (52)	38 (52)	18 (27)	15 (31)	^a .	<0.001
Use of earplugs	95 (18)	0	0	4 (12)	0	3 (8)	9 (13)	10 (20)	4 (6)	38 (57)	14 (29)	13 (16)	<0.001

All data are n (%) ^a. question not asked in this country

ESM- 5 Pharmacological interventions to improve sleep

N (%)	All (n=522)	Cyprus (n=10)	Denmark (n=26)	Germany (n=34)	Greece (n=27)	Italy (n=36)	Nether- lands (n=69)	Norway (n=50)	Poland (n=73)	Sweden (n=67)	UK (n=48)	Canada (n=82)	P value All (N=522)
Benzodiazepines:													
*Lorazepam	157 (30)	4 (40)	0	24 (71)	2 (7)	27 (75)	30 (44)	8 (16)	11 (15)	6 (9)	5 (10)	40 (49)	<0.001
*Temazepam	110 (21)	0	0	5 (15)	1 (4)	0	52 (75)	24 (48)	1 (1)	0	20 (42)	7 (9)	<0.001
*Nitrazepam	43 (8)	2 (20)	0	3 (9)	0	2 (6)	1 (1)	17 (34)	10 (14)	8 (12)	0	0	<0.001
Melatonin	84 (16)	0 (0)	0	5 (15)	4 (15)	4 (11)	3 (4)	36 (72)	6 (8)	11 (16)	12 (25)	3 (4)	<0.001
Rohypnol	55 (11)	0	0	0	0	3 (8)	0	49 (98)	1 (1)	2 (3)	0	0	<0.001
Promethazine	32 (6)	0	0	4 (12)	0	2 (6)	6 (9)	0	17 (23)	2 (3)	0	1 (1)	<0.001
Chloral hydrate	7 (1)	0	0	1 (3)	0	0	1 (1)	1 (2)	1 (1)	1 (2)	2 (4)	0	0.669

All data are n (%)